June 1971 Brief 71-10172

NASA TECH BRIEF

NASA Headquarters

Preparation of Homogeneous Vitreous Materials for Electronic and Optical Devices

The problem:

To devise a laboratory process for preparing certain vitreous or polycrystalline chalcogenides, particularly mixed selenides of arsenic and antimony, $x(As_2Se_3)\cdot y(Sb_2Se_3)$, that are chemically and physically homogeneous and can be formed in well-defined shapes to close dimensional tolerances. Control of these properties is essential for use of the materials in electronic and optical devices.

The solution:

A process in which the vitreous material is built up as a series of solidified layers on the inside walls of a sealed quartz ampule containing the molten constituents of the material.

How it's done:

The desired proportions of the pure compounds (for example, the selenides of arsenic and antimony) are placed in a cylindrical quartz ampule, which is then evacuated and sealed. The sealed unit, fitted to the end of a horizontal motor shaft, is inserted into a furnace opening and maintained above the melting temperature of the compounds for about 60 seconds. During this heating period, the ampule is rotated to blend the molten compounds. It is then withdrawn from the furnace, and, while under a reduced rate of rotation (about a horizontal axis), is allowed to cool at room temperature. As the ampule slowly cools, the molten, viscous material becomes uniformly distributed in concentric layers on the inside surface of the ampule and progressively solidifies into a homogeneous cylindrical deposit. When the process is completed, the solid deposit separates from the inner surface of the quartz ampule because the quartz has a lower thermal expansion coefficient than the deposited material.

Notes:

1. The ampules can be of various shapes, and different methods can be used for effecting a controlled relative motion between the ampules and molten compounds.
2. The ampules must be made of a material which does not react with the melt and has a lower thermal expansion coefficient than that of the solidified layer.
3. Requests for further information may be directed to:

   Headquarters
   National Aeronautics
   and Space Administration
   Washington, D.C. 20546
   Reference: TSP71-10172

Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act (42-USC 2457 (f)), to the Massachusetts Institute of Technology, Cambridge, Massachusetts.

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under a grant from
NASA Headquarters
(HQN-10670)

Category 04